

CHAPTER 6

GEOTECHNICAL

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CHAPTER 6

GEOTECHNICAL

6.1 GENERAL.

This chapter outlines the content of the Foundation Report to be provided to all designers for use in design and incorporated in the various submittal stages. The Mobile District(MDO), or a contractor hired by MDO or the designer shall provide to the designer a comprehensive Foundation Report as soon as it can be formulated after notice to proceed. If the designer arranges the geotechnical investigation, the designer, or his consultant, shall be required to plan and conduct a geotechnical investigation of the proposed site based on the Statement of Work (SOW). The report shall present the results of the subsurface investigation and laboratory testing and shall offer recommendations for the design of structure foundations, pavements, and other geotechnical features. Logs of borings shall be provided as an appendices to the Foundation Report, design analysis, and contract specifications using ENG Form 1836 and ENG Form 1836a for continuation pages unless otherwise approved. Specifications for all earthwork operations and specialty items such as dewatering systems, piling operations, slope stabilization, etc., shall be provided. Specialty field tests such as ph measurements, resistivity tests, and percolation tests shall be included for use in design, if appropriate. The designer shall be responsible for selecting the structure foundation type based on the recommendations offered in the Foundation Report. The designer shall be responsible for insuring that the Foundation Report contains all the required data to design the foundation, to include items such as construction and permanent dewatering, pile driving, slope stabilization, etc. It shall be the designers responsibility to insure that the geotechnical investigation adequately characterizes the site geology and hydrogeology and that all data required to complete the project design is collected and analyzed. This chapter also lists the specific requirements of the submittal stages for geotechnical design features. The Foundation Report including logs of borings and laboratory test data shall be made a part of the Design Analysis and shall be reviewed by MDO if the Foundation Report was not prepared by MDO. The Foundation Report may be submitted for review prior to the conventional submittal dates if time permits. The designer should contact the Geotechnical and Dam Safety Section if there are any questions about the content of the Foundation Report or the features required by the various submittal stages or if the project has been resited.

6.2 APPLICABLE PUBLICATIONS.

6.2.1 ASTM Specifications.

Many of the "Guide Specifications" reference ASTM specifications. Most of the ASTM specifications which are usually referenced by geotechnical specifications can be found in volume 04.08 of ASTM. Listed below are the most frequently used ASTM specifications. These specifications or their updated versions should be referenced.

- | | |
|----------|--|
| C 117-90 | Test Method for Material Finer Than 75 -um(n o.200) Sieve in Material Aggregates for Washing |
| C 136-84 | Method for Sieve Analysis of Fine and Coarse Aggregates |

D 420-87 Recommended Practice for Investigating and Sampling Soil and Rock for Engineering Purposes

D 421-85 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

D 422-63 Method for Particle-Size Analysis of Soils

D 653-90a Terminology relating to Soil, Rock and Contained Fluids

D 698-91 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³) (600kN-m-m/3)

D 1140-54 Test Method for Amount of Material in Soils Finer Than the No. 200 (75-um) Sieve

D 1241 Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses

D 1452-80 Practice for Soil Investigation and Sampling by Auger Borings (1990)

D 1556-90 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D 1557-91 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

D 1586-84 Method For Penetration Test and Split-Barrel Sampling of Soils

D 1587-83 Method For Thin-Walled Tube Sampling of Soils

D 2113-83 Method for Diamond Core Drilling for Site Investigation (1987)

D 2167-84 Test Method for Density and Unit Weight of Soil In-Place by the Rubber Balloon Method (1990)

D 2216-90 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

D 2487-90 Classification of Soils for Engineering Purposes

D 2488-90 Practice for Description and Identification of Soils (Visual-Manual Procedure)

D 2922-91 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D 2937-83 Test Method for Density of Soil in Place by the Drive-Cylinder.

D 3017-78 Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D 3740-88 Practice for Evaluation of Agencies Engaged in Testing and/ or Inspection of Soil and Rock as Used in Engineering Design

ASTM D 4043-91 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques

- ASTM D 4044-91 Test Method (Field Procedure) for Instantaneous Change in Head (Slug Test) for Determining Hydraulic Properties of Aquifers.
- D 4318-84 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D 4428/4428M-91 Test Method for Crosshole Seismic Testing
- D 4718-87 Practice for the Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
- D 4829-88 Test Method for Expansion Index of Soils
- G 57-78 Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method
- G 57-78 Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method (1984)

6.2.2 Government Technical Publications.

The following Government technical manuals should be used in conjunction with the ASTMS for foundation design coupled with the design requirements of other chapters herein.

- AFM 88-3 Soils and Geology: Procedures for Foundation Design of Buildings and Other Structures (Chapter 7)
- EM 1110-1-1-1904 Settlement Analysis
- EM 1110-1-1-1905 Bearing Capacity of Soils

See Chapter 4 and 11 titled SITE DEVELOPMENT and STRUCTURAL for additional publications to be used in the design of roads and buildings.

6.3 PROJECT DEFINITION (10-15%).

The Project Definition Submittal should have a geotechnical chapter that states the known general geology and physiology of the project site. The chapter should state the site's history and its status as a potential site of Hazardous and Toxic Waste (HTW) contamination. The chapter should further state the status of the foundation investigation and report.

6.4 CONCEPT DESIGN (30-35%).

6.4.1 Design Analysis.

(a) Incorporate recommendations stated in the Foundation Report into the design.

(b) Provide foundation design calculations using parameters outlined in the Report and include a copy of the Report in the design analysis.

(c) Notify the Geotechnical branch of any conflicts between the Foundation Report and concept design. If the topographic surveys are to be

performed by the designer, then an electronic file copy in a DGN format of the survey must be sent to the entity performing the geotechnical investigation, as soon as possible but no later than the date for the submittal of the 35% design.

(d) Include boring logs and laboratory test data as an appendix.

6.4.2 Design Drawings.

(a) Locate soil borings, test pits, monitoring wells and piezometers on the civil site plan. Add the appropriate symbol to legend.

(b) Add note to civil site plan: "For logs of borings and test data, see ___." and reference the appendix that includes boring logs and test data.

6.5 INTERIM DESIGN (50-60%).

Comply with the accepted comments on the concept design.

6.6 FINAL DESIGN (UNREVIEWED 100%).

6.6.1 General.

(a) Comply with comments on the interim review.

(b) Return the specifications provided by MDO along with designer prepared specifications for final review.

6.6.2 Design Analysis.

(a) Incorporate recommendations stated in the Foundation Report into the design.

(b) Provide foundation design calculations using parameters outlined in the Report, and include a copy of the Foundation Report in the design analysis.

(c) Notify the Geotechnical branch of any conflicts between Foundation Report and final design.

(d) Include boring logs and laboratory test data as Appendix 'A' of the specifications. Provide separate Adobe Acrobat Portable Document Format files named logs.pdf and tests.pdf for Appendix 'A'. Include "General Notes", "Soil Classification Legend", "Rock Classification Legend" if applicable, and Abbreviations pages at the beginning of the logs.pdf file, followed by the boring logs. Include laboratory test data in the file tests.pdf. Do not include the narrative portion of the Foundation Report or any sections or profiles containing interpretations of subsurface data in Appendix 'A'.

6.6.3 Design Drawings.

(a) Locate soil borings, test pits, monitoring wells and piezometers on civil site plan. Add the appropriate symbol to legend.

(b) Add note to civil site plan: "For logs of borings and test data, see ___" and reference the appendix that includes boring logs and test data.

6.7 READY TO ADVERTISE (100%).

(a) Comply with comments on the final design review.

(b) Include any drawings and specifications prepared by MDO in the Index of Drawings and the Table of Contents for specifications.

(c) Include boring logs and laboratory test data as Appendix 'A' of the specifications. Provide separate Adobe Acrobat Portable Document Format files named logs.pdf and tests.pdf for Appendix 'A'. Include "General Notes", "Soil Classification Legend", "Rock Classification Legend" if applicable, and Abbreviations pages at the beginning of the logs.pdf file, followed by the boring logs. Include laboratory test data in the file tests.pdf. Do not include the narrative portion of the Foundation Report or any sections or profiles containing interpretations of subsurface data in Appendix 'A'.

6.8 TECHNICAL REQUIREMENTS.

6.8.1 Deep Foundations.

The Foundation Report shall provide recommendations for the type of deep foundation system to be used (piling, caissons, etc.), the size and length of the piling, the estimated tip elevation, and the allowable bearing capacity of each pile. The designer shall be responsible for selecting the type of deep foundation to be used, determine the number of piles, actual spacing, and the pile cap design. If caissons are used the designer shall insure that the report addresses the caisson diameter, embedment depth, top of sound rock, number of caissons, spacing during installation, and allowable bearing capacity. The number and location of test piles and load tests to be specified in the construction contract should be recommended. The designer shall be responsible for securing all required geotechnical data during the geotechnical investigation if so tasked.

6.8.2 Temporary Construction and Permanent Dewatering Systems.

6.8.2.1 Temporary Construction Dewatering.

Based on the results of the geotechnical investigation the designer shall be responsible for determining project dewatering requirements. Short term construction dewatering due to poor surface drainage, precipitation, or short duration work at or near the water table is generally considered a contractor responsibility. Using information from the Foundation Report, the designer should alert the contractor to any known conditions that shall require short term dewatering.

When temporary construction dewatering shall be required due to a consistently high water table or the effects of underlying artesian aquifers the designer shall design and present a dewatering plan in sufficient detail that the contractor can bid on and install the dewatering system. The designer shall be responsible for securing all the required information necessary for the design of the system (aquifer properties, geotechnical analyses of sediments, etc.) during the geotechnical investigation. For construction dewatering designs the use of slug tests to determine aquifer

characteristics (hydraulic conductivity, transmissivity, storage coefficient, etc.) shall not be acceptable.

6.8.2.2 Permanent Dewatering Systems.

The designer shall be responsible for securing the required aquifer properties and hydrogeologic data during the geotechnical investigation. The selection of well screen slot sizes, screen lengths, discharge pipe sizes, installation methods, etc. shall be the responsibility of the designer. The use of slug tests to determine aquifer characteristics (hydraulic conductivity, transmissivity, storage coefficient, etc.) shall not be acceptable.

6.8.3 Earth Liners.

The geotechnical investigation should provide the designer with the overall geologic conditions, the in situ and constructed permeabilities that can be obtained using native materials and stabilizing agents, liner types and thicknesses, and slope stabilization requirements. The designer shall be required to apply for all necessary permits. As part of the permitting process he shall be required to determine the classification of the material to be contained, the permeability necessary to contain the material, and the size and functional configuration of the containment area. No earth liners shall be permitted when material to be retained has a Ph below 5.

6.8.4 Cathodic Protection and Grounding Systems.

The geotechnical investigation should include all ph tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. The raw field data shall be provided in the Foundation Report without interpretation or recommendations. The designer shall design all corrosion control and grounding systems required for the project and shall advise MDO immediately if additional field data is required.

6.8.5 Permanent Water Well Design and Construction.

If required by the SOW, the designer shall be required to determine the location of the well, verify the gpm requirements, verify future demands based on facility estimates, and determine the pump size and type. The permanent well design shall be based on data collected from the installation and aquifer testing of a pilot well. Test well borings shall be continuously sampled and visually logged by a qualified geologist. Additionally, the borehole shall geophysically logged to verify the visual log. Sediment samples from the anticipated production zone(s) shall be analyzed for grain size distribution and any other required parameters to assist in the design of the well. The completed design shall specify casing sizes and lengths, grouted intervals, well screen slot size(s), screen length, filter pack gradation, centralizer locations, and testing requirements to insure the straightness and plumbness of the borehole and completed well.

6.8.6 Structures.

The Foundation Report shall recommend the type of foundation system to be used, the allowable bearing capacity, the depth of placement and bearing elevations for the footings, and the floor slab preparation. The designer shall size all footings, grade beams, slabs, etc., utilizing the recommendations and restrictions presented in the Foundation Report.

Earthwork specification for the structures shall be prepared by the designer. See Chapter 11 titled STRUCTURAL for further design requirements.

6.8.7 Pavements.

The Foundation Report shall recommend for pavement subgrades the allowable design CBR and modulus of subgrade reaction parameters along with the required compaction effort. Guidance shall be offered on the types of base course materials available in the area and design strengths. The designer shall prepare all earthwork specifications for pavement subgrades. The designer shall prepare all pavement material specifications with consultation from the Geotechnical Branch. See Chapter 4 titled SITE DEVELOPMENT, for deviations or exceptions.

6.8.8 General Earthwork and Special Features.

The Foundation Report shall recommend undercutting requirements, fill and backfill placement procedures, types of compaction equipment to be used, and outline earthwork procedures for special features such as retaining walls, embankment construction, earth covering of structures, basements, buried and mounded tanks, utilities, etc. The designer shall prepare all earthwork specifications (Mobile District sections 02221, 02222, and 02225) for the general conditions. The Geotechnical Branch shall assist the designer in the preparation of specifications for any special features. For projects requiring gabion or riprap slope protection, the designer shall coordinate with the Geotechnical & Dam Safety Section (EN-GG) for required materials investigations and/or specification requirements. Notification of the proposed slope protection should be given EN-GG as soon as possible so as to allow time for any needed sampling and testing.

APPENDIX 'A' - LOGS OF BORINGS AND TEST DATA

GENERAL NOTES:

1. GROUNDWATER DEPTHS OR ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER ENCOUNTERED ON THE DATES SHOWN. ABSENCE OF GROUNDWATER DATA ON CERTAIN BORINGS IMPLIES THAT NO DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THE LOCATIONS. GROUNDWATER ELEVATIONS VARY AND SEEPAGE ABOVE THE DEPTHS OR ELEVATIONS SHOWN CAN BE EXPECTED AT ANY TIME.

2. WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL MINOR VARIATIONS IN CHARACTERISTICS OF THE SUBSURFACE MATERIALS ARE ANTICIPATED AND, IF ENCOUNTERED, SUCH VARIATIONS WILL NOT BE CONSIDERED AS DIFFERING MATERIALLY FROM THE DESCRIPTION SHOWN WITH THE LOGS OR PROFILES.

3. SOILS ARE CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, ASTM-D-2487, CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES.

4. DRIVING RESISTANCES (BLOW COUNTS OR N VALUES) ARE DETERMINED WITH A STANDARD SPLIT SPOON SAMPLER (1-3/8" I.D.) AND A 140-LB DRIVING HAMMER WITH A 30" DROP UNLESS OTHERWISE NOTED ON THE BORING LOGS. N VALUES SHOWN NUMERICALLY ON THE LOGS ARE THE SUM OF BLOWS FOR THE LOWER TWO OF THREE 0.5-FOOT DRIVES THAT MAKE UP THE 1.5-FOOT STANDARD PENETRATION TEST, EXCEPT WHEN REFUSAL OCCURS. REFUSAL OF THE SPLITSPoon IS DEFINED AS 50 BLOWS IN LESS THAN A 0.5-FOOT DRIVE. REFUSAL IS SHOWN ON THE LOGS AS INDICATED IN THE FOLLOWING EXAMPLES:

50/0.3' - INDICATES 50 BLOWS (REFUSAL) AFTER 0.3' PENETRATION IN THE FIRST DRIVE.

20, 50/0.2' - INDICATES 20 BLOWS IN THE FIRST DRIVE AND REFUSAL AFTER 0.2' PENETRATION IN THE SECOND DRIVE.









20, 85/0.8' - INDICATES 20 BLOWS IN THE FIRST DRIVE, 35 BLOWS IN THE SECOND DRIVE AND REFUSAL (50 BLOWS) AFTER 0.3' PENETRATION IN THE THIRD DRIVE.

5. "MAX SIZE" OF GRAVEL OR ROCK FRAGMENTS SHOWN ON THE BORING LOGS REPRESENTS THE MAXIMUM SIZE OF MATERIAL RECOVERED IN THE DRIVE SAMPLER AND/OR CORE BARREL OR OBSERVED FROM AUGERING UNLESS OTHERWISE NOTED. NOTE THAT THE MAXIMUM LOGGED SIZE OF GRAVEL OR ROCK FRAGMENTS IS LIKELY TO BE SMALLER THAN THE MAXIMUM SIZE OF THE IN-PLACE MATERIAL, ESPECIALLY WHEN THE MAXIMUM LOGGED SIZE IS MORE THAN APPROXIMATELY ONE-HALF THE DIAMETER OF THE DRIVE SAMPLER OR CORE BARREL, OR MORE THAN ONE-THIRD THE DIAMETER OF THE AUGER.

6. CLASSIFICATIONS SHOWN IN COLUMN D OF THE BORING LOG FORM ARE THE DRILLING INSPECTOR'S FIELD VISUAL CLASSIFICATION OF SAMPLES UNLESS OTHERWISE INDICATED ON THE LOG. WHEN AVAILABLE, LABORATORY CLASSIFICATIONS OF SAMPLES ARE SHOWN IN COLUMN G (REMARKS COLUMN) UNLESS OTHERWISE INDICATED.










SOIL CLASSIFICATION LEGEND

COARSE-GRAINED SOILS - MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE

GW		WELL GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
SW		WELL GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
SM		SILTY SANDS, SAND-SILT MIXTURES
SM-H		SAME AS ABOVE WITH HIGH LIQUID LIMIT
SC		CLAYEY SANDS, SAND-CLAY MIXTURES
SC-H		SAME AS ABOVE WITH HIGH LIQUID LIMIT

NOTE: DUAL CLASSIFICATIONS, E.G. SP-SM, GP-GM, ML-CL AND SM-SC, ARE SHOWN BY PLACING BOTH SYMBOLS SIDE BY SIDE.

FINE-GRAINED SOILS - MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE

ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SANDY SILTS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTY SOIL, PLASTIC SILTS
OL		ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
PT		PEAT AND OTHER HIGHLY ORGANIC SOILS
		BITUMEN, ASPHALT, OR ASPHALTIC CONCRETE
		CONCRETE

ROCK CLASSIFICATION LEGEND



SANDSTONE



RHYOLITE



SILTSTONE OR CLAYSTONE



BASALT



SHALE



GRANITE



CEMENTED SHALE



GNEISS



LIMESTONE



CONGLOMERATE



DOLOMITE



CHERT



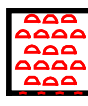
SCHIST



COAL



PHYLLITE



**SHELL, SHELL FRAGMENTS,
OR SHELL-SOIL MIXTURE
CONSISTING MOSTLY OF SHELL**



QUARTZITE



**VOID (CAVITY,
OPEN JOINT, ETC.)**



**NOT SAMPLED OR
SAMPLE NOT RECOVERED**

ABBREVIATIONS

@	AT
ACCUM	ACCUMULATED
ALT	ALTERNATING
ANG	ANGULAR
APPROX.	APPROXIMATE (LY)
ARGIL	ARGILLACEOUS
AUG	AUGER
AVG	AVERAGE
B.A.	BASE OF ALLUVIUM
B.I.	BREAKAGE INTERVAL
B.O.H.	BOTTOM OF HOLE
BBL	BARREL
BDD	BED (ED) (DING)
BDR	BEDROCK
BENT.	BENTONITIC
BGE	BEIGE
BKY	BLOCKY
BL	BLACK (ISH)
BLD	BOULDER
BR	BROWN (ISH)
BREC.	BRECCIATED
BRK	BROKEN, BREAKAGE
C.D.	CORRECTED DEPTH
CAL	CALCITE, CALCAREOUS
CARB	CARBONACEOUS
CAV	CAVITY
CBL	COBBLE
CEM	CEMENT
CHT	CHERT
CIRCLE.	CIRCULATION
CLY	CLAYEY
CMT'D	CEMENTED
CNTR (S)	CONCENTRATION (S)
COMP	COMPACT
CONC	CONCRETE
CONCR	CONCRETIONS
CONGL	CONGLOMERATE
CONT.	CONTINUED
CR'D	CRUSHED
CRM	CRUMBLY
CSE	COARSE
CTD	COATED
D.	DENSE
d.	DEPTH
D.A.	DRILL ACTION
D.T.	DRILL TIME
D.W.L.	DRILL WATER LOSS
D.W.R.	DRILL WATER RETURN
DECOM	DECOMPOSED
DIAG	DIAGONAL
DIS.	DISSEMINATED
DK	DARK
DOL.	DOLOMITE, DOLOMITIC
DRL	DRILLING
DSTG	DISINTEGRATE (D)
EL	ELEVATION
ENC	ENCOUNTERED
EST	ESTIMATE (D)
EXCL	EXCLUDING
EXTR	EXTREMELY
F.	FINE (LY)
F.R.	FLUID RETURN
F/T	FISHTAILED
FE	IRON
FERR	FERRUGINOUS
FIS	FISSILE
FLD	FILLED
FM	FORMATION

ABBREVIATIONS

FOLIA.	FOLIATION
FOS	FOSSIL (IFEROUS)
FRAC	FRACTURE
FRAG	FRAGMENT (S)
G.W.	GROUNDWATER
GEN.	GENERALLY
GLAU	GLAUCONITE (ITIC)
GR	GRAY (ISH)
GRA	GRAIN (ED)
GRAD	GRADATIONAL
GRN	GREEN (ISH)
GRT	GROUT
GVL	GRAVEL (LY)
GYP	GYPSUM
H/A	HIGH ANGLE
H/B	HAMMER BREAK
HD	HARD
HI	HIGH (LY)
HLD	HEALED
HMR	HAMMER
HOR	HORIZONTAL
HYD	HYDRAULIC
INCL	INCLUDING (ED)
INDT	INDURATED
INIT	INITIAL (LY)
INTBDD	INTERBED (DED)
INTLAM	INTERLAMINATED
IRR	IRREGULAR (LY)
JT'S	JOINT'S
JTD	JOINTED
L.C.	LOSE CORE
L.D.W.	LOST DRILL WATER
L/A	LOW ANGLE
LAB.	LABOR
LAM	LAMINATED, LAMINA (NAE)
LAY.	LAYER
LEA	LEACHED
LGE	LARGE
LIG	LIGNITIC
LIT	LITTLE
LL	LIQUID LIMIT
LN. (S)	LENSE (S)
LO	LOOSE
LS	LIMESTONE
LT	LIGHT
MAS	MASSIVE
MAX	MAXIMUM
MECH	MECHANICAL
MED	MEDIUM
MIC	MICACEOUS
MIN	MINIMUM
MINR	MINERALIZED (IZATION)
MIX.	MIXTURE
MOD	MODERATE (D)
MOT	MOTTLED (ING)
MST	MOIST
MTL	MATERIAL
MTX	MATRIX
N/A	NOT APPLICABLE
N/E	NOT ENCOUNTERED
N/R	NO RECOVERY
NOD.	NODULE
NUM	NUMEROUS
OB	OVERBURDEN (UNCLASSIFIED)
OBS	OBSERVED
OCC	OCCASIONAL (LY)
OOL	OOLITE, OOLITIC
OP	OPEN (ED)
OR	ORANGE

ABBREVIATIONS

ORG	ORGANIC
P.S.I.	POUNDS/SQ. IN.
P.T.	PRESSURE TEST
PART.	PARTIALLY
PCS	PIECES
PERTRO	PETROLEUM, PETROLIFEROUS
PHOS	PHOSPHATE (PHOROUS)
PI	PLASTICITY INDEX
PIT	PIT (TED) (TING)
PKT (S)	POCKET (S)
PL	PLASTIC LIMIT
PLA	PLATY
PLAS	PLASTIC
PLN	PLANE
PNK	PINK
PR	POORLY
PRED	PREDOMINATED
PRESS	PRESSURE
PROB	PROBABLE (ABILITY)
PTC	PARTICLES
PTG	PARTING
PUR	PURPLE
QTZ	QUARTZ
QTZE	QUARTZITE
R.Q.D.	ROCK QUALITY DESIGNATION
RBL	RUBBLE
RD	RED (DISH)
REC	RECOVERY
RECEM	RECEMENTED
RND	ROUND (ED)
RTS	ROOTS
S/S	SPLIT
SAP	SAPROLITE
SAT	SATURATED
SCAT.	SCATTEREDLY
SCH (S)	SCHIST (OS)
SD	SAND
SDY	SANDY
SH	SHALE
SI	SILT
SIS	SILTSTONE
SIY	SILTY
SL	SLIGHT (LY)
SLCES	SILICEOUS
SLICK.	SLICKENSIDE
SML	SMALL
SO	SOFT
SOL	SOLUTION (ED) (ING)
SPG	SPECIFIC GRAVITY
SPT	STANDARD PENETRATION TEST
SPT	STANDARD SPLITSPOON
SS	SANDSTONE
ST	STRAIN (ED) (ING)
STF	STIFF
STR	STRUCTURE
STRG	STRINGER
STYL	STYLOLITE (OLITIC)
SUR	SURFACED
T.F.R.	TOP OF FIRM ROCK
T.O.R.	TOP OF ROCK
T.S.R.	TOP OF SOUND ROCK
TEXT.	TEXTURE
THK	THICK
THN	THIN
TI	TIGHT
TN	TAN (NISH)
TR	TRACE
TRP	TRIPOLI

ABBREVIATIONS

UD	UNDISTUBED
UL	UNACCOUNTABLE LOSS
UNACC	UNACCOUNTABLE
UNWEA	UNWEATHERED
V/	VERY
VERT	VERTICAL
VGY	VUGGY
W.C.	WATER CONTENT
W.L.	WATER LEVEL
W/	WITH
W/H	WEIGHT OF HAMMER
W/R	WEIGHT OF ROD
WD	WOOD
WEA	WEATHERED
WG	WEIGH
WHT	WHITE
X-BDD	CROSS-BEDDED
XL	CRYSTAL
XLN	CYRSTALLINE
YEL	YELLOW

Hole No.

DRILLING LOG		DIVISION		INSTALLATION		SHEET OF SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. ELEVATION DATUM			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number)				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERTICAL				15. ELEVATION GROUNDWATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			
				DRAFTED		CHECKED	
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR W.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	

ENG FORM 1836 (Facsimile)

PROJECT

HOLE NO.

DRILLING LOG (Cont Sheet)			ELEVATION TOP OF HOLE		Hole No.	
PROJECT			INSTALLATION			SHEET OF SHEETS
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR W.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

ENG FORM 1836-A (focsimle)

PROJECT

HOLE NO.

GEOTECHNICAL REPORT CHECKLIST

1. Describe general site access with respect to mobility or drilling or other test equipment. Field sketches of existing utilities, fences, walkways and pavements should be made to compare to the topography map.
2. Generally describe the site topography and note all the topographic features that effect the project.
3. Describe the slope of the ground surface and delineate all drainage channels and any previous cut and fill or erosion.
4. Describe existing structures, pavements, or other obstructions and the procedures for demolition.
5. Fully describe the results of the subsurface investigation and any laboratory testing and its impacts on constructing the project.
6. GENERAL SCOPE:
 - a. Results of fdn. investigation & testing
 - b. Recommendations based on (a) above.
7. DETAIL INFORMATION:
 - a. Description of structure(s)
 - (1) Written general description
 - (2) Type of construction contemplated.
 - (3) Size and Height
 - (4) Finished Floor elevation; Elevation of existing ground
 - (5) Type of Foundation recommended
 - (6) Approximate load (s)
 - (7) Special Features affecting Foundation Design
 - (a) Water Table, or history of dewatering or seepage problems
 - (b) Condition or history of nearby buildings
 - (c) Analyze whether dewatering would cause settlement of adjacent structures
 - (d) Location of fill or dump areas near site which may jeopardize foundation
 - (e) Existing buried Utilities conflict with new foundations
 - b. Specific recommendations for foundation design and/or construction based on site features.
 - (1) Topography
 - (2) Surface Water
 - (3) Groundwater
 - (4) Subsurface soil conditions
 - (5) Availability of borrow materials
 - (6) Location & availability of spoil areas
 - (7) Permitting actions required.
 - c. Results and/or Recommendations for:
 - (1) Bearing capacity

EXH-6-8

- (2) Piles (Type, length, capacity, type of installations)
 - (3) Retaining Walls or basement walls
 - (4) Mat Foundations
 - (5) Slope Stability
 - (6) Settlement
 - (7) Permanent ground water drainage around or under structures
 - (8) Construction Dewatering
 - (9) Erosion control during and after construction
- d. Revisions, additions, and/or deletions to the standard guide specs resulting from the foundation analysis.
- (1) Include a copy of the specification as it is proposed to be used.
 - (2) Mention the major changes in the write-up and the reason for making them.
- e. Design Calculations
- (1) Include applicable design calculations on settlement, bearing capacity, seepage, uplift, stability analysis, quantities, shrinkage, dewatering, etc.
 - (2) Show formulas, assumptions and reference source
- f. Site Plan
- (1) Show building road locations
 - (2) Contours
 - (3) Boring, test pit, infiltrometer locations
 - (4) Locations of temporary & permanent surface water diversion measures.
 - (5) Location of buried utility line (existing & to be installed)
- g. Logs of all boring and test pits in Adobe Acrobat Portable Document Format in file named logs.pdf. Make sure the logs have horizontal control to the nearest foot and vertical control to the nearest tenth of a foot shown for each log.
- h. Results of all laboratory test data in Adobe Acrobat Portable Document Format in file named tests.pdf.
- i. Detailed Dewatering design, if it is to be a major foundation cost.

EXH-6-8 Cont.

PLANS AND SPECIFICATIONS SUBMITTAL CHECKLIST

GENERAL

1. Coordinate index of drawings with the title of each sheet.
2. Coordinate the title of the drawings with the title of the specifications.
3. Coordinate drawings for scale and dimension.
4. Reference related views and details.
5. Orientate all drawings and plan views by north arrow.
6. Clearly define limits of the contractor's and owner's responsibility, i.e. Owner furnished - contractor installed equipment or materials, Owner furnished - owner installed equipment or materials, Contractor furnished - Contractor installed equipment or materials
7. Proofread applicable sections of the specifications after typing.
8. Coordinate technical provisions terminology of the specifications for compatibility against the drawings.
9. Provide written responses to comments on the previous submittal. Check that the accepted comments have been incorporated.
10. Show haul routes, disposal areas, borrow areas, bench marks, and all general type contractor information.
11. Check that boring logs and test data have been properly included as Adobe Acrobat Portable Document Files logs.pdf and tests.pdf for Appendix 'A' of the specifications.

TECHNICAL

1. Check if allowable soil or rock bearing values are shown on structural sheet.
2. Check logs of borings and test results for accuracy with respect to location, elevation, classification, water level, etc.
3. Check that previous accepted comments have been incorporated into drawings and/or specifications.

EXH-6-9